

SAMSUNG

ELECTRONICS

Approval

Customer :Visual Display Division**DATE : 02.Dec.2009****SAMSUNG TFT-LCD****MODEL : LTF400HF16(BN07-00802A)**Any Modification of Specification is not allowed without SEC's Permission.

NOTE :

Customer's Approval

SIGNATURE

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02.Dec.2009

LCD Business

Samsung Electronics Co . , LTD.

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Revision History

Date	Rev. No	Page	Summary
02.Dec. 2009	000	all	First issued

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General Description

Description

LTF400HF16 is a color active matrix liquid crystal display (LCD) that uses amorphous silicon TFT(Thin Film Transistor) as switching components. This model is composed of a TFT LCD panel, a driver circuit and a back light unit. The resolution of a 40.0" is 1920 x 1080 and this model can display up to 1.07 Billion colors with wide viewing angle of 89° or higher in all directions. This panel is intended to support applications to provide a excellent performance for Flat Panel Display such as Home-alone Multimedia TFT-LCD TV and High Definition TV.

Features

- RoHS compliance (Pb-free)
- High contrast & aperture ratio with wide color gamut
- SPVA(Super Patterned Vertical Align) mode
- Wide viewing angle ($\pm 178^\circ$)
- High speed response
- FHD resolution (16:9)
- Low Power consumption
- 12 Normal CCFL (Cold Cathode Fluorescent Lamp)
- DE(Data Enable) mode
- 4Ch-LVDS (Low Voltage Differential Signaling) interface (4pixel/clock)

General Information

Items	Specification	Unit	Note
Module Size	952.0(H _{TYP}) x 551.0(V _{TYP})	mm	± 1.0mm
	55.4(D _{MAX})		
Weight	8,580 (Max.)	g	
Pixel Pitch	0.46125(H) X 0.46125 (W)	mm	
Active Display Area	885.6(H) X 498.15(V)	mm	
Surface Treatment	Haze 5.5%, Hard-coating (2H)		Anti-Glare
Display Colors	1.07 Billion (10bit Dithering)	colors	
Number of Pixels	1920 x 1080	pixel	
Pixel Arrangement	RGB vertical stripe		
Display Mode	Normally Black		
Luminance of White	500	cd/m ²	

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1. Absolute Maximum Ratings

If the condition exceeds maximum ratings, it can cause malfunction or unrecoverable damage to the device.

(V_{SS} = 0 V)

Item		Symbol	Min.	Max.	Unit	Note
Power Supply Voltage		V _{DD}	10.8	13.2	V	(1)
Storage temperature		T _{STG}	-20	65	°C	(2)
Glass surface temperature (Operation)	Center	T _{OPR}	0	50	°C	(2),(5)
	T. Uniformity	△T	-	10	°C	
Shock (non - operating)		S _{nop}	± X, ± Y	-	40	G
			± Z	-	30	
Vibration (non - operating)		V _{nop}	-	1.5	G	(4)

Note (1) Ta= 25 ± 2 °C

(2) Temperature and relative humidity range are shown in the figure below.

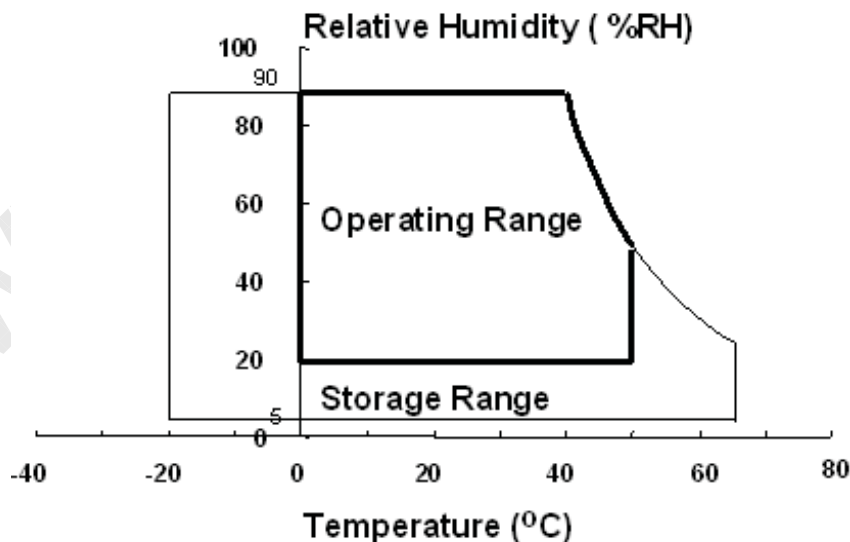
a. 90 % RH Max. (Ta ≤ 39 °C)

b. Relative Humidity is 90% or less. (Ta > 39 °C)

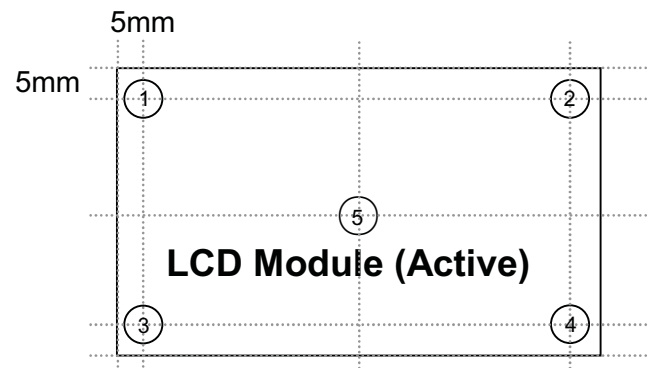
c. No condensation

(3) 11ms, sine wave, one time for ± X, ± Y, ± Z axis

(4) 10-300 Hz, Sweep rate 10min, 30min for X,Y,Z axis



(5) Definition of test point



ΔT should be less than $10\text{ }^{\circ}\text{C}$ ($\Delta T = |T_{\text{OPR}} - T_{\text{MAX}}|$)

T_{OPR} : Temperature of the center of the glass surface (Test point 5)

$T_1 \sim T_4$: Temperature of each edge of the glass surface

T_{MAX} : The highest temperature of the glass surface

2. Optical Characteristics

The optical characteristics should be measured in a dark room or equivalent.

Measuring equipment : TOPCON RD-80S, TOPCON SR-3 ,ELDIM EZ-Contrast

(Ta = 25 ± 2℃, VDD=12V, fv= 120Hz, IL = 15 mA)

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio (Center of screen)		C/R	Normal $\theta L,R=0$ $\theta U,D=0$ Viewing Angle	-	6000	-		(1) SR-3
Response Time	G-to-G	Tg		-	6	10	msec	(3) RD-80S
Luminance of White (Center of screen)		Y _L		400	500	-	cd/m ²	(4) SR-3
Color Chromaticity (CIE 1931)	Red	R _x		TYP. -0.03	0.640	TYP. +0.03		(5),(6) SR-3
		R _y			0.340			
	Green	G _x			0.300			
		G _y			0.600			
	Blue	B _x			0.150			
		B _y			0.060			
	White	W _x			0.280			
		W _y	0.290					
Color Gamut		-	-	72	-	%	(5) SR-3	
Color Temperature		-	-	10000	-	K		
Viewing Angle	Hor.	θ _L	C/R≥10	79	89	-	Degree	(6) EZ-Contrast
		θ _R		79	89	-		
	Ver.	θ _U		79	89	-		
		θ _D		79	89	-		
Brightness Uniformity (9 Points)		B _{uni}		-	-	25	%	(2) SR-3

- Test Equipment Setup

The measurement should be executed in a stable, windless and dark room between 40min and 60min after lighting the back light at 25 ± 2℃ for stabilization of the back light. This should be measured in the center of screen.

Lamp current : 15.0 mA

Environment condition : Ta = 25 ± 2℃

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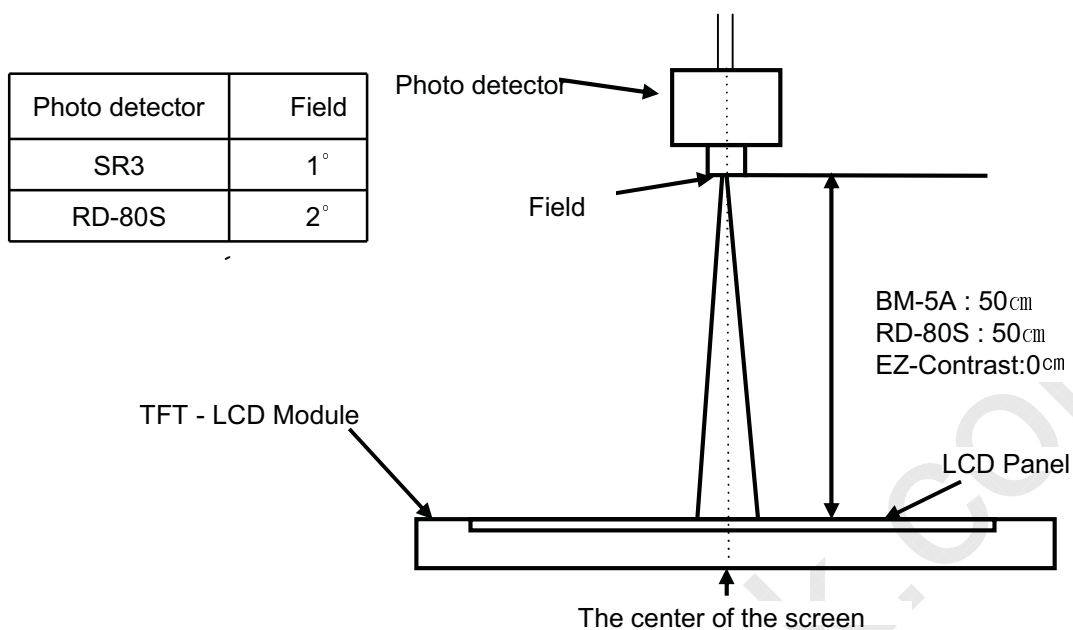
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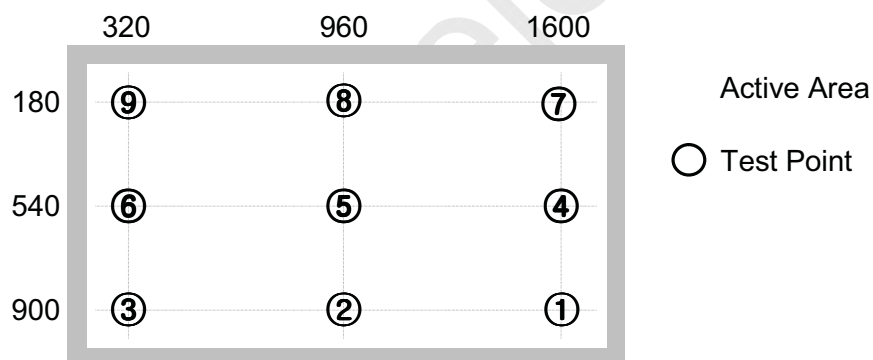
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- Definition of test point



Note (1) Definition of Contrast Ratio (C/R)

: Ratio of gray max (Gmax) & gray min (Gmin) at the center point ⑤ of the panel

$$C/R = \frac{G_{\max}}{G_{\min}}$$

Gmax : Luminance with all pixels white

Gmin : Luminance with all pixels black

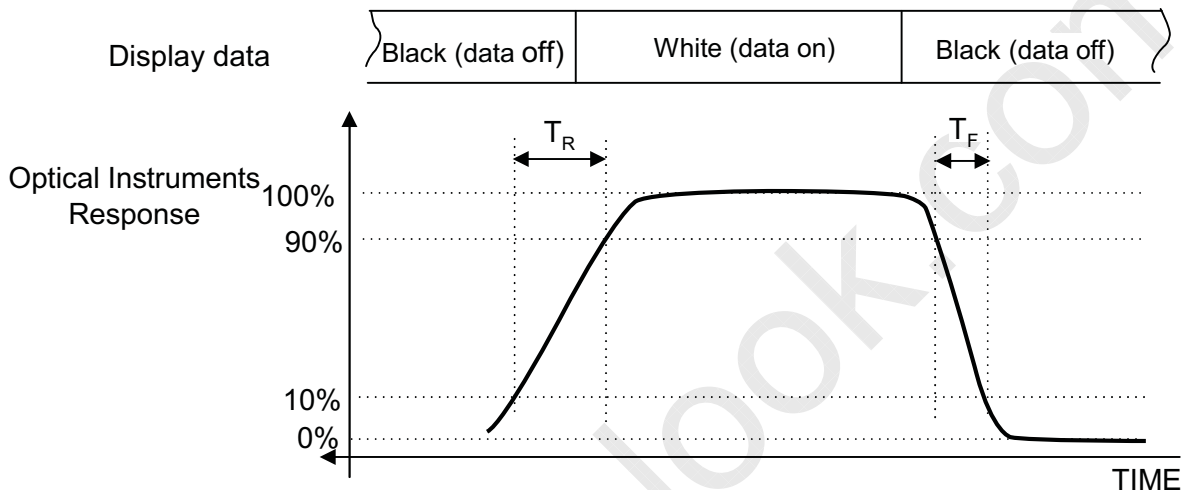
Note (2) Definition of 9 points brightness uniformity (Test pattern : Full White)

$$B_{uni} = 100 * \frac{(B_{max} - B_{min})}{B_{max}}$$

B_{max} : Maximum brightness

B_{min} : Minimum brightness

Note (3) Definition of Response time : Sum of T_r, T_f



※ G- to- G : Average response time between Gray to Gray (Scale)

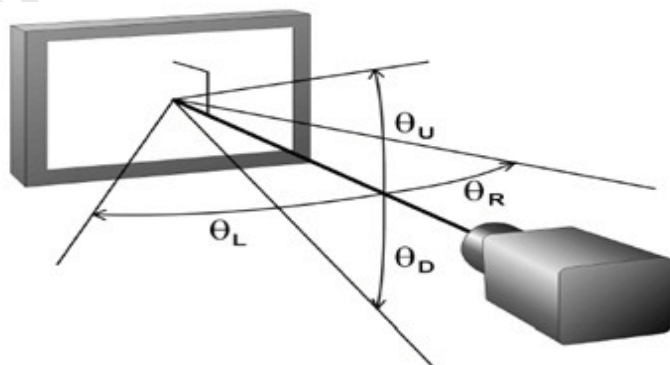
Note (4) Definition of Luminance of White : Luminance of white at center point ⑤

Note (5) Definition of Color Chromaticity (CIE 1931)

Color coordinate of Red, Green, Blue & White at center point ⑤

Note (6) Definition of Viewing Angle

: Viewing angle range (C/R ≥ 10)



3. Electrical Characteristics

3.1 TFT LCD Module

The connector for display data & timing signal should be connected.

$T_a = 25^{\circ}\text{C} \pm 2^{\circ}\text{C}$

Item		Symbol	Min.	Typ.	Max.	Unit	Note
Voltage of Power Supply		V _{DD}	10.8	12.0	13.2	V	(1)
Current of Power Supply	(a) Black	I _{DD}	-	500	600	mA	(2),(3)
	(b) White		-	500	600	mA	
	(c) Sub V-stripe		-	1000	1200	mA	
Vsync Frequency		f _V	95	120	125	Hz	
Hsync Frequency		f _H	120	135	140	kHz	
Main Frequency		Fdclk	260	297	305	MHz	
Rush Current		I _{RUSH}	-	-	7	A	(4)

Note (1) The ripple voltage should be controlled under 10% of V_{DD} .

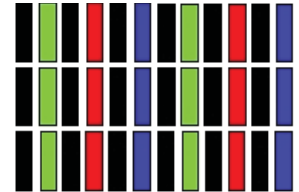
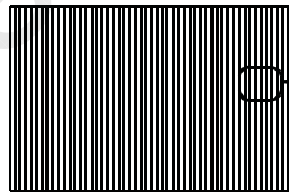
(2) $f_V = 120\text{ Hz}$, $f_{DCLK} = 297\text{ MHz}$, $V_{DD} = 12.0\text{V}$, DC Current.

(3) Power dissipation check pattern (LCD Module only)

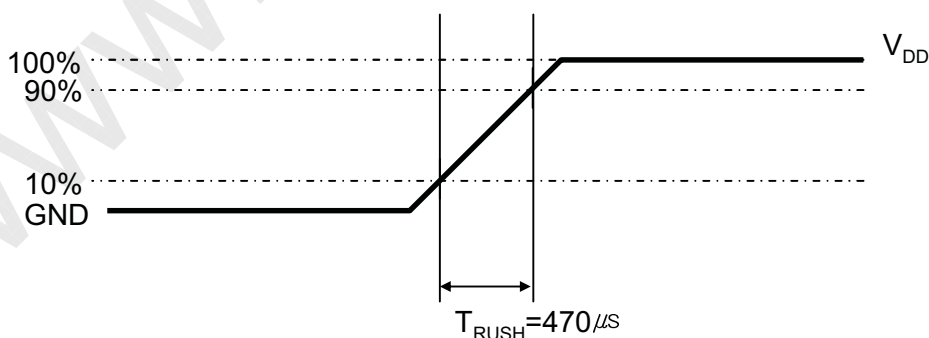
a) Black Pattern

b) White Pattern

c) Sub V-stripe



(4) Measurement Conditions

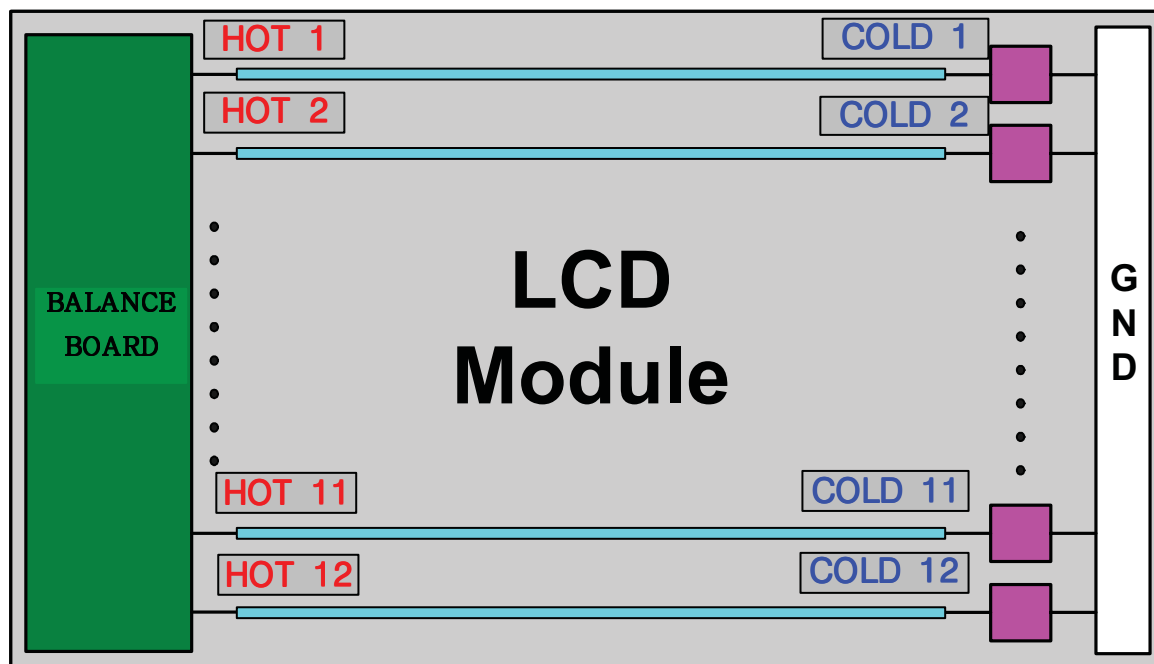


Rush Current I_{RUSH} can be measured when T_{RUSH} is $470\mu\text{s}$.

3.2 Back Light Unit

The back light unit contains 12 Normal type CCFLs (Cold Cathode Fluorescent Lamp).

$T_a = 25 \pm 2^\circ\text{C}$

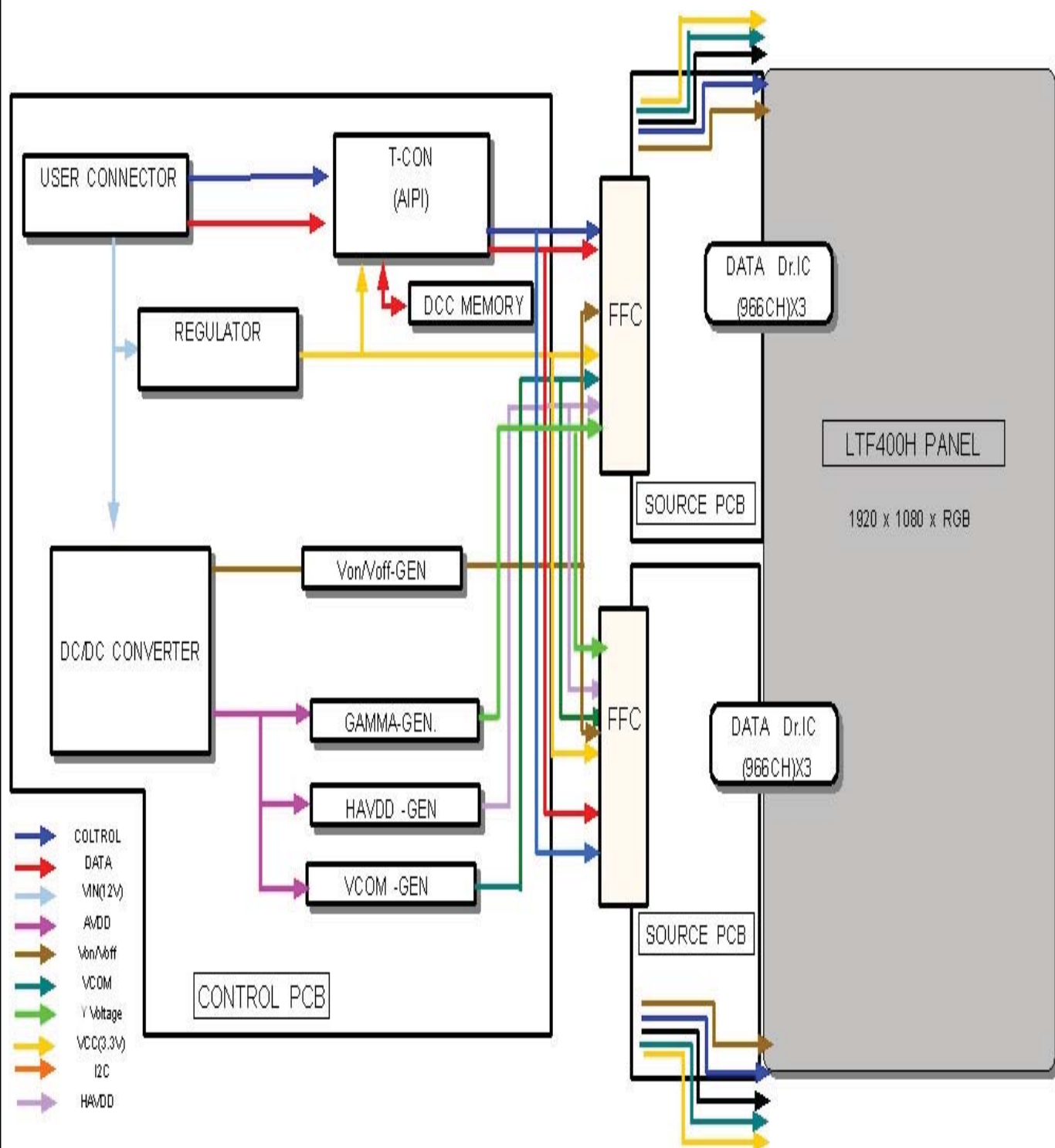


Item	Symbol	Min.	Typ.	Max.	Unit	Note
Operating Life Time	Hr	50000	-	-	Hour	(1)

Note (1) It is defined as the time to take until the brightness reduces to 50% of its original value.

[Operating condition : $T_a = 25 \pm 2^\circ\text{C}$, $I_L = 15\text{mA}$, For single lamp only.]

4. Block Diagram

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5. Input Terminal Pin Assignment

5.1. Input Signal & Power

Connector : 82Pin(UJU)

Pin	Description		Pin	Description	
1	Vdd (12V)		43	B_INT	
2	Vdd (12V)		44	SDA_I	
3	Vdd (12V)		45	LVDS_SEL	NOTE 2
4	Vdd (12V)		46	No connection	NOTE 1
5	Vdd (12V)		47	No connection	NOTE 1
6	No connection	NOTE 1	48	No connection	NOTE 1
7	GND		49	No connection	NOTE 1
8	GND		50	No connection	NOTE 1
9	GND		51	HVS1	
10	Odd LVDS Signal	B[10]N	52	GND	
11		B[10]P	53	Even LVDS Signal	B[4]4P
12		B[11]N	54		B[4]4N
13		B[11]P	55		B[4]3P
14		B[12]N	56		B[4]3N
15		B[12]P	57		GND
16		GND	58		B[4]CLK+
17		B[1]CLK-	59		B[4]CLK-
18		B[1]CLK+	60		GND
19		GND	61		B[4]2P
20		B[13]N	62		B[4]2N
21	Odd LVDS Signal	B[13]P	63	Even LVDS Signal	B[4]1P
22		B[14]N	64		B[4]1N
23		B[14]P	65		B[4]0P
24		GND	66		B[4]0N
25		B[3]0N	67		GND
26		B[3]0P	68	Even LVDS Signal	B[2]4P
27		B[3]1N	69		B[2]4N
28		B[3]1P	70		B[2]3P
29		B[3]2N	71		B[2]3N
30		B[3]2P	72		GND
31		GND	73		B[2]CLK+
32		B[3]CLK-	74		B[2]CLK-
33		B[3]CLK+	75		GND
34		GND	76		B[2]2P
35		B[3]3N	77		B[2]2N
36	Odd LVDS Signal	B[3]3P	78		B[2]1P
37		B[3]4N	79		B[2]1N
38		B[3]4P	80		B[2]0P
39		GND	81		B[2]0N
40		SCL_I	82	GND	
41	No connection	NOTE 1			
42	No connection	NOTE 1			

Note1) No Connection: This PINS are only used for SAMSUNG internal using.

Note2) LVDS OPTION : If this PIN is HIGH (3.3 V) → Normal LVDS format

LOW (GND) → JEIDA LVDS format

SEQUENCE : On = VDD(T1) → LVDS Option → Interface Signal(T2)

OFF = Interface Signal(T3) → LVDS Option → VDD

Note3) # Pin 6 : NC (to protect EOS)

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Note(1) Pin number starts from Bottom side

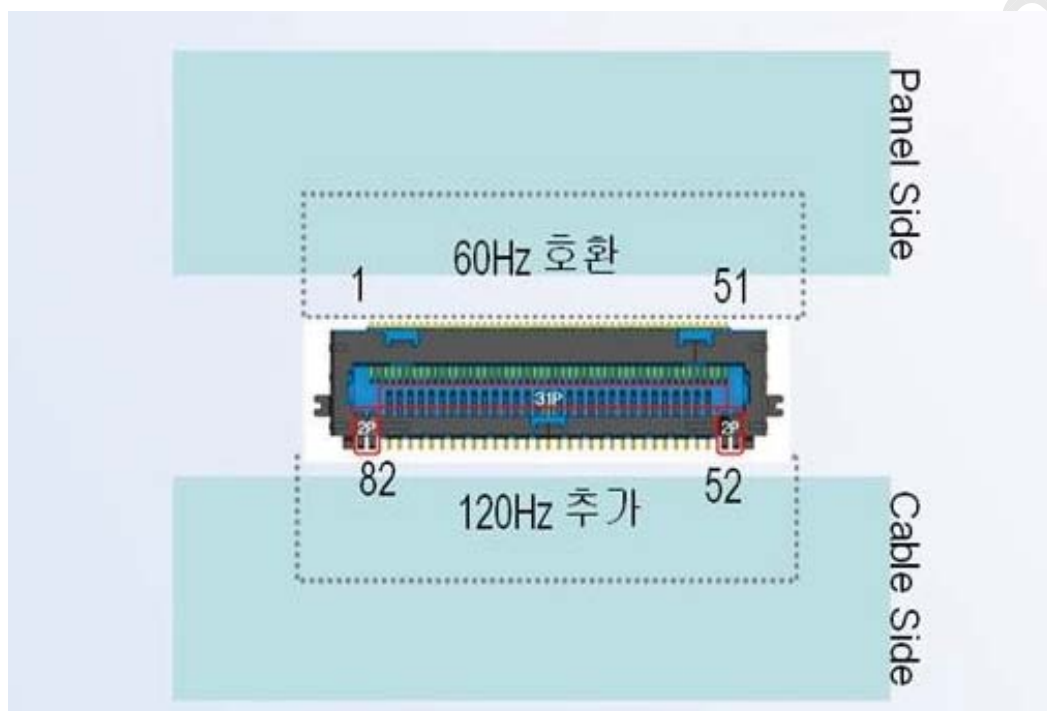


Fig. Connector diagram

- a. Power GND pins should be connected to the LCD's metal chassis.
- b. All power input pins should be connected together.
- c. All NC pin should be separated from other signal or power.

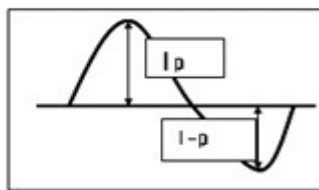
5.2. Balance Board

5.2.1 Operation Condition

Item	Symbol	Recommendation			Unit	Note	Remark
		Min.	Typ.	Max.			
Total Input Current	I_T	165	183	201	mA	(1)	At Dimming 100%
Inverter Frequency	F_{OP}	44.5	45	45.5	kHz		Switching Frequency
Dimming Frequency	F_{DIM}	140	150	160	Hz		-
Dim Duty Ratio	D_{PWM}	15	-	100	%	-	Bright Control
Striking Voltage	HV_{STRIKE}	1500	-	3000	Vrms	(2) (3)	-
Striking Time	T_{STRIKE}	1.0	-	-	Sec		

Note [1] Asymmetric ratio must less than 10 % $|I_p - I_n| / I_{rms} < 0.1$

Crest factor must be from 90 % to 110 % $0.9 < I_p \text{ or } I_n / (I_{rms} \times \sqrt{2}) < 1.1$



- Unbalance rate : $|I_p - I_n| / I_{rms} < 10\%$
- Distortion rate : $I_p \text{ (or } I_n) / I_{rms}$

[2] Striking Voltage (HV_{STRIKE}) based on CCFL spec. at 0°C ambient temperature.

Striking Mode Operation Requirement

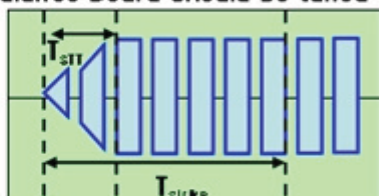
- Soft Start Time (T_{SST}) < 10msec
- PWM Dimming < 90%
- No current flows in PWM Dimming Off Period

Normal PWM Dimming Operation

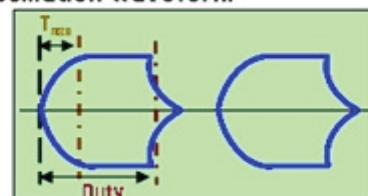
- PWM Dimming Rising/Falling Time $T_{rise} < 200\mu\text{sec}$

T_{rise} can be tuned for minimizing Acoustic Noise Emission

IP and Balance Board should be tuned without oscillation waveform



Lamp Current (Striking Model)



Lamp Current (PWM Dimming Model)

[3] Striking Mode from IP must be maintained until all of lamps turn on (within Lamp Strike Time)

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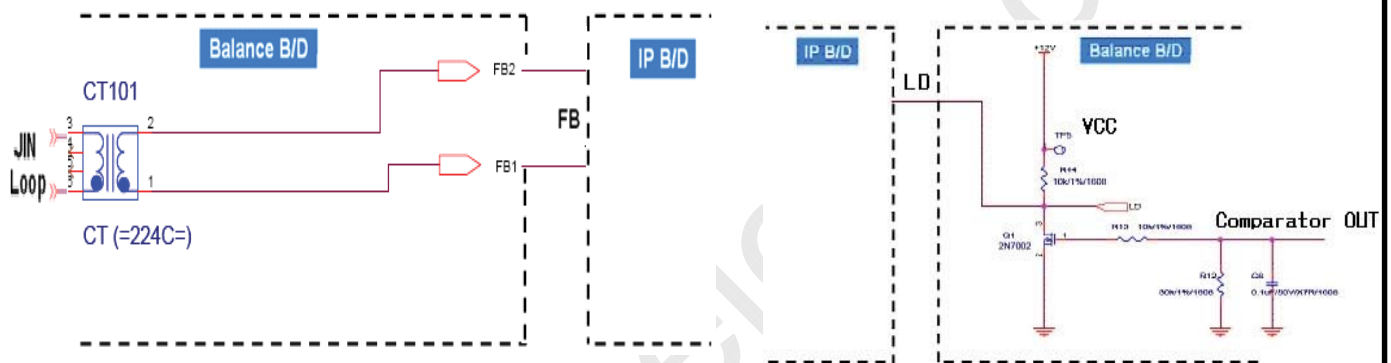
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5.2.2 Feedback I/O Specification

ITEM		SYMBOL	Recommendation			UNIT	Note	REMARKS
			Min.	Typ.	Max.			
Supply Voltage		V_{CC}	10	12	14	Vdc	-	
Input Current		I_C	2.0	-	100	mA		at Recommended Load Condition
Lamp Detection	High	V_{LD}	$V_{CC}-0.5$	-	V_{CC}	V	(2)	Normal : High Abnormal : Low
	Low		-	-	1			

Balance board FB Output

Balance board LD Output



5.2.3 Balance Board Pin map

1) CN104 Connector : KN30-7P-1.25H(001) (Hirose)

Pin NO	SYMBOL	REMARK
1	$V_{CC}(+12V)$	Power Supply for Protection Circuit
2,3	FB1,FB2	Lamp Current Detected Voltage
4,5	GND	Signal Ground
6,7	LD	CCFL Connector Open & Non- lighting signal

2) CN 101 Connector : 130001WR-02E(YENHO)

Pin NO	SYMBOL	REMARK
1	HV1	High Voltage Normal Polarity Input
2	HV2	

2) CN 102 Connector : SM02-BDAS-10-VD (JST)

Pin NO	SYMBOL	REMARK
1	HV1	High Voltage Normal Polarity Input
2	HV1	

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5.3 LVDS Interface

- LVDS Receiver : Tcon (merged)
- Data Format (JEIDA&VESA)

	LVDS pin	JEIDA -DATA	VESA-DATA
TxOUT/RxIN0	TxIN/RxOUT0	R2	R0
	TxIN/RxOUT1	R3	R1
	TxIN/RxOUT2	R4	R2
	TxIN/RxOUT3	R5	R3
	TxIN/RxOUT4	R6	R4
	TxIN/RxOUT6	R7	R5
	TxIN/RxOUT7	G2	G0
TxOUT/RxIN1	TxIN/RxOUT8	G3	G1
	TxIN/RxOUT9	G4	G2
	TxIN/RxOUT12	G5	G3
	TxIN/RxOUT13	G6	G4
	TxIN/RxOUT14	G7	G5
	TxIN/RxOUT15	B2	B0
	TxIN/RxOUT18	B3	B1
TxOUT/RxIN2	TxIN/RxOUT19	B4	B2
	TxIN/RxOUT20	B5	B3
	TxIN/RxOUT21	B6	B4
	TxIN/RxOUT22	B7	B5
	TxIN/RxOUT24	HSYNC	HSYNC
	TxIN/RxOUT25	VSYNC	VSYNC
	TxIN/RxOUT26	DEN	DEN
TxOUT/RxIN3	TxIN/RxOUT27	R0	R6
	TxIN/RxOUT5	R1	R7
	TxIN/RxOUT10	G0	G6
	TxIN/RxOUT11	G1	G7
	TxIN/RxOUT16	B0	B6
	TxIN/RxOUT17	B1	B7
	TxIN/RxOUT23	RESERVED	RESERVED



5.4 Input Signals, Basic Display Colors and Gray Scale of Each Color

COLOR	DISPLAY (8bit)	DATA SIGNAL																										GRAY SCALE LEVEL
		RED								GREEN								BLUE										
		R0	R1	R2	R3	R4	R5	R6	R7	G0	G1	G2	G3	G4	G5	G6	G7	B0	B1	B2	B3	B4	B5	B6	B7			
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-		
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	-		
	GREEN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	-		
	CYAN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-		
	RED	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-		
	MAGENTA	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	-		
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	-		
	WHITE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-		
GRAY SCALE OF RED	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R0		
	DARK ↑	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1		
		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R2		
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	R3~ R252		
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:			
	↓ LIGHT	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R253	
		0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R254	
	RED	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R255	
GRAY SCALE OF GREEN	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G0		
	DARK ↑	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G1		
		0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G2		
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	G3~ G252		
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:			
	↓ LIGHT	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	G253	
		0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	G254	
	GREEN	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	G255	
GRAY SCALE OF BLUE	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B0		
	DARK ↑	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	B1		
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	B2		
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	B3~ B252		
		:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:			
	↓ LIGHT	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	B253	
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	B254	
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	B255	

Note) Definition of Gray :

Rn : Red Gray, Gn : Green Gray, Bn : Blue Gray (n = Gray level)

Input Signal : 0 = Low level voltage, 1 = High level voltage

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6. Interface Timing

6.1 Timing Parameters (DE only mode)

SIGNAL	ITEM	SYMBOL	MIN.	TYP.	MAX.	Unit	NOTE
Clock	Frequency	$1/T_C$	260	297	305	MHz	-
Hsync		F_H	120	135	140	KHz	-
Vsync		F_V	95	120	125	Hz	-
Vertical Display Term	Active Display Period	T_{VD}	-	1080	-	Lines	(4)
	Vertical Total	T_V	1092	1125	1350	Lines	-
Horizontal Display Term	Active Display Period	T_{HD}	-	1920	-	Clocks	(4)
	Horizontal Total	T_H	2092	2200	2348	clocks	-

Note) This product is DE only mode. The input of Hsync & Vsync signal does not have an effect on normal operation.

(1) Test Point : TTL control signal and CLK at LVDS Tx input terminal in system

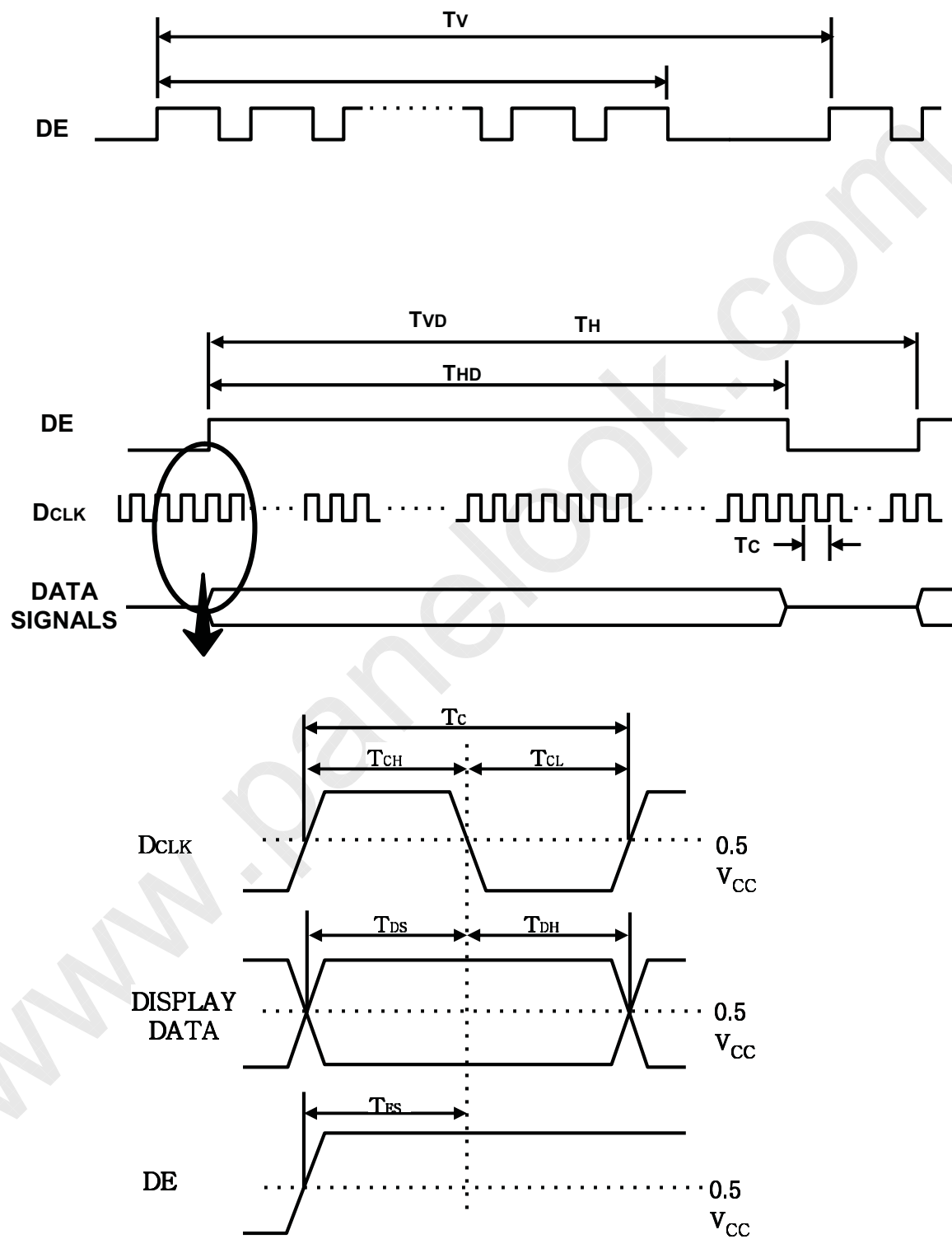
(2) Internal $V_{DD} = 3.3V$

(3) Spread spectrum

- Modulation rate (max) : $\pm 1.5 \%$

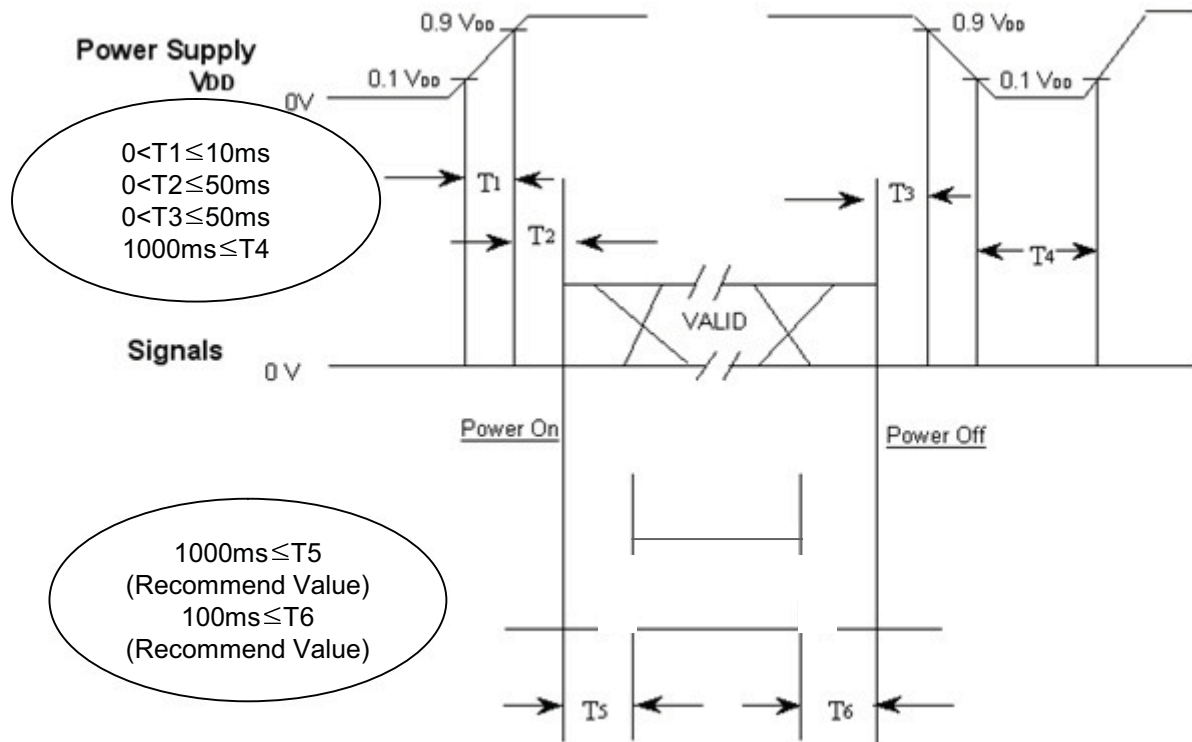
- Modulation Frequency : Within 300KHz

6.2 Timing diagrams of interface signal (DE only mode)



6.3 Power ON/OFF Sequence

To prevent a latch-up or DC operation of the LCD Module, the power on/off sequence should be as the diagram below.



T₁ : V_{DD} rising time from 10% to 90%

T₂ : The time from V_{DD} to valid data at power ON.

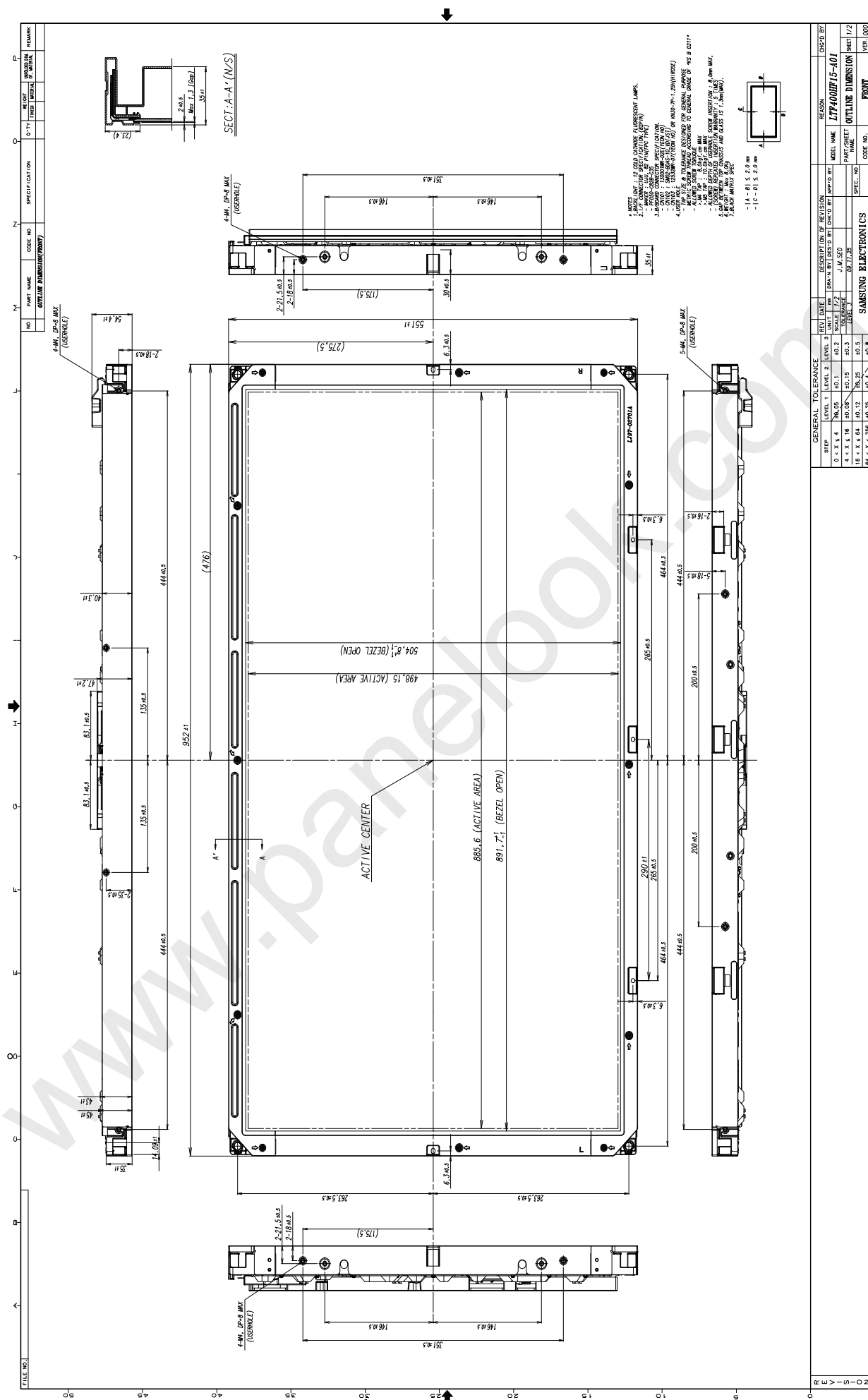
T₃ : The time from valid data off to V_{DD} off at power Off.

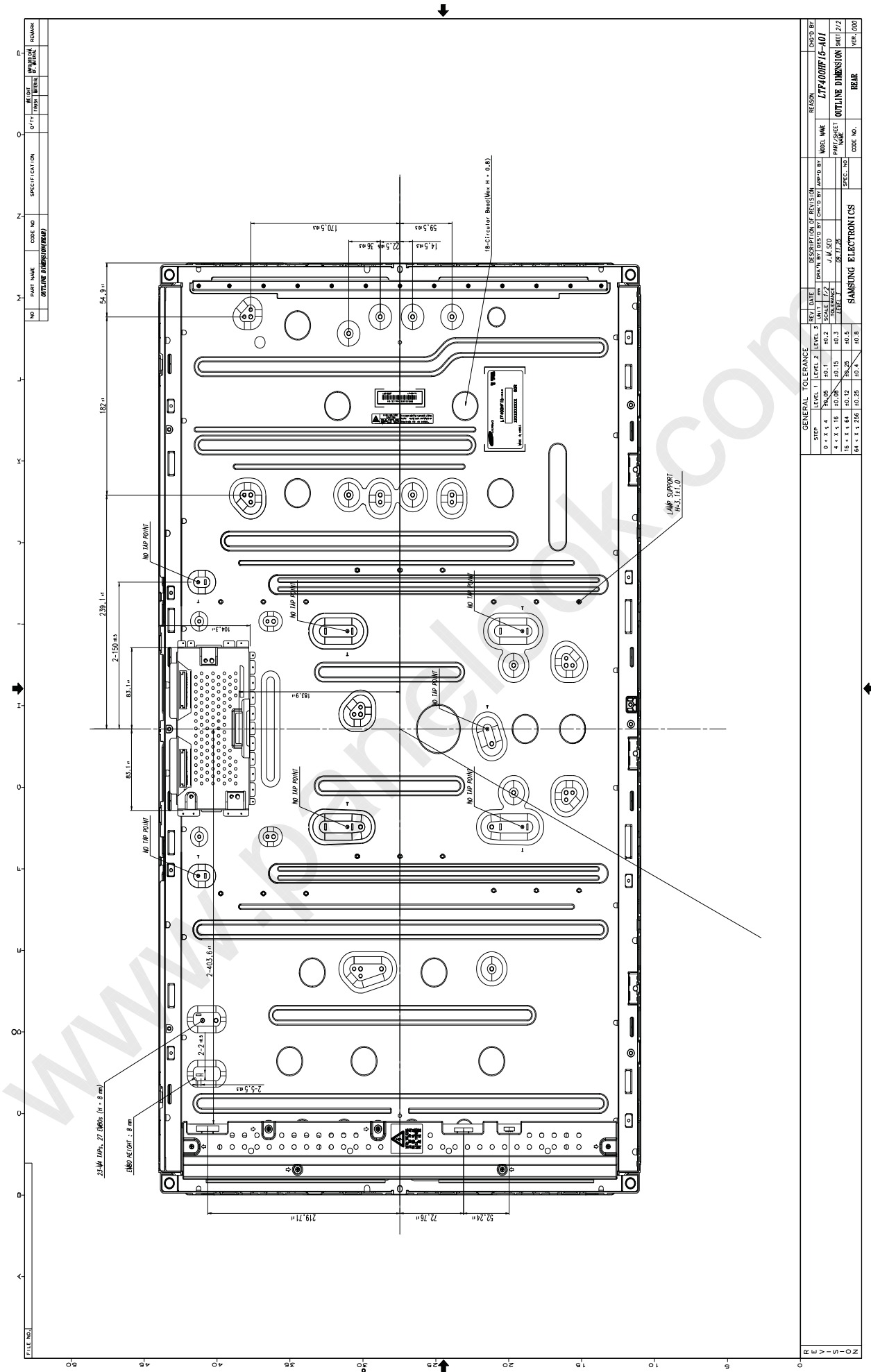
T₄ : V_{DD} off time for Windows restart

T₅ : The time from valid data to B/L enable at power ON.

T₆ : The time from valid data off to B/L disable at power Off.

- The supply voltage of the external system for the Module input should be the same as the definition of V_{DD}.
- Apply the lamp voltage within the LCD operation range. When the back light turns on before the LCD operation or the LCD turns off before the back light turns off, the display may momentarily show abnormal screen.
- In case of V_{DD} = off level, please keep the level of input signals low or keep a high impedance.
- T₄ should be measured after the Module has been fully discharged between power off and on period.
- Interface signal should not be kept at high impedance when the power is on.





8. Reliability Test

Item	Test condition	Quantity
Temperature Step stress	-20℃ ~ 60℃, 10Cycle, 80hr	4EA
HTOL	50℃ operation, 1000hr	8EA
LTOL	0℃ operation, 1000hr	4EA
LTOL 2	-20℃, -10℃ Each condition over 5hr off, over 1hr on	4EA
HTS	70℃ storage, 500hr	4EA
LTS	-30℃ storage, 500hr	4EA
THB	40℃ / 95%RH, 30sec On / Off, 500hr operation	4EA
WHTS	60℃ / 75%RH, 500hr	4EA
Thermal Shock	-20℃ (30min) ~ 60℃ (30min) storage, 200cycle	4EA
ALTITUDE	-10℃ ~ 45℃, 0 ~ 40,000ft, 18hr	2EA
ESD	contact : ± 8 kV, 150pF/330Ω, 200Point, 1 time/Point (operation) non-contact : ± 15 kV, 150pF/330Ω, 200Point, 1 time/Point (operation) Inverter input pin : ± 15 kV, 150pF/330Ω, 3 times/Pin	3EA
Vibration	10~300Hz/1.5G/10minSR, XYZ, 30min/axis	3EA
Shock	11msec, ± XYZ 1time/axis ~15Kg 50G, 11msec 15Kg ~ 20Kg ± XY 40G ± Z 30G, 11msec 20Kg ~ 30G, 11msec	3EA
Noise	On 90 min / Off 90 min	2 EA
Dust	5hr on/off (yellow earth 5sec spread / 5 min precipitation)	2 EA
Short term Image sticking	25~50℃ Mosaic pattern (9*10) 12hr fix	8 EA
Long term Image sticking	50℃ Mosaic pattern (9*10) 504hr fix	4 EA
PALLET Vibration	1.05 Grms, Random, Z axis 1Hr	1PALLET(10EA)
PALLET Drop	20cm, 4Edge(Bottom), 1Face(Bottom)	1PALLET(10EA)

[Result Evaluation Criteria]

Under the display quality test conditions with normal operation state, these should be no change which may affect practical display functions.

- * HTOL/ LTOL : High/Low Temperature Operating Life
- ** THB : Temperature Humidity Bias
- *** HTS/LTS : High/Low Temperature Storage
- **** WHTS : Wet High Temperature Storage

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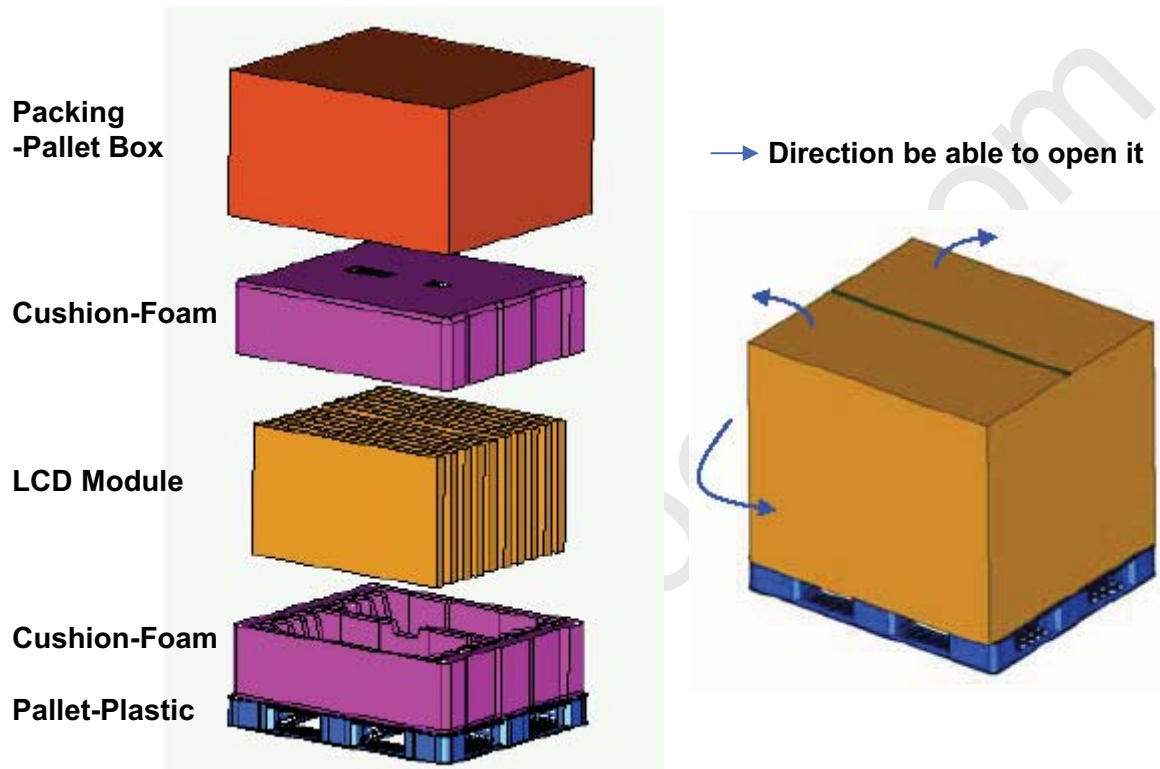
9. PACKING

9.1 CARTON (Internal Package)

(1) Packing Form

Corrugated fiberboard box and corrugated cardboard as shock absorber

(2) Packing Method



9.2 Packing Specification

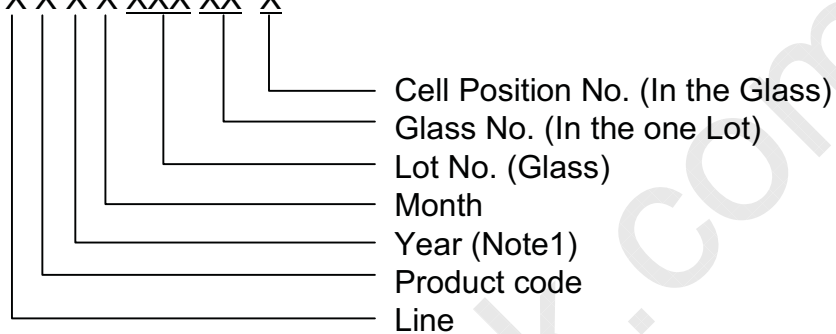
Item	Specification	Remark
LCD Packing	10ea / (Packing-Pallet Box)	1. 80 Kg / LCD (10ea) 2. 7 Kg / Cushion-pallet (2ea) 3. 6.7 Kg / Packing-Pallet Box (1ea) 4. Cushion-pallet Material : EPS 5. Packing-Pallet Box Material : DW4
Pallet	1Box / Pallet	1. Pallet weight = 8kg
Packing Direction	Vertical	
Total Pallet Size	H x V x height	1150mm(H) x 985mm(V) x 609mm(height)
Total Pallet Weight	101.7 kg	Pallet(8kg) + Module(8*10=80) + Cushion(up+bottom=7kg) + Pallet-BOX(6.7kg)

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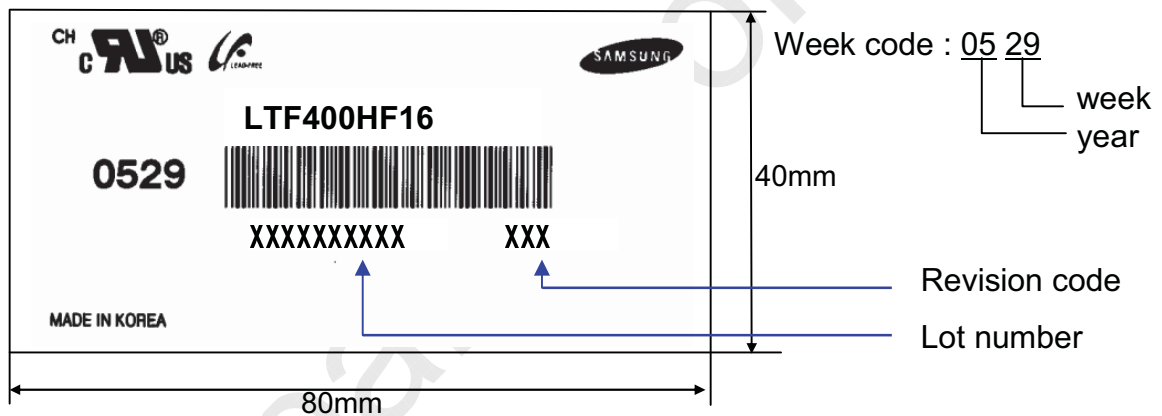
10. MARKING & OTHERS

A nameplate bearing followed by is affixed to a shipped product at the specified location on each product.

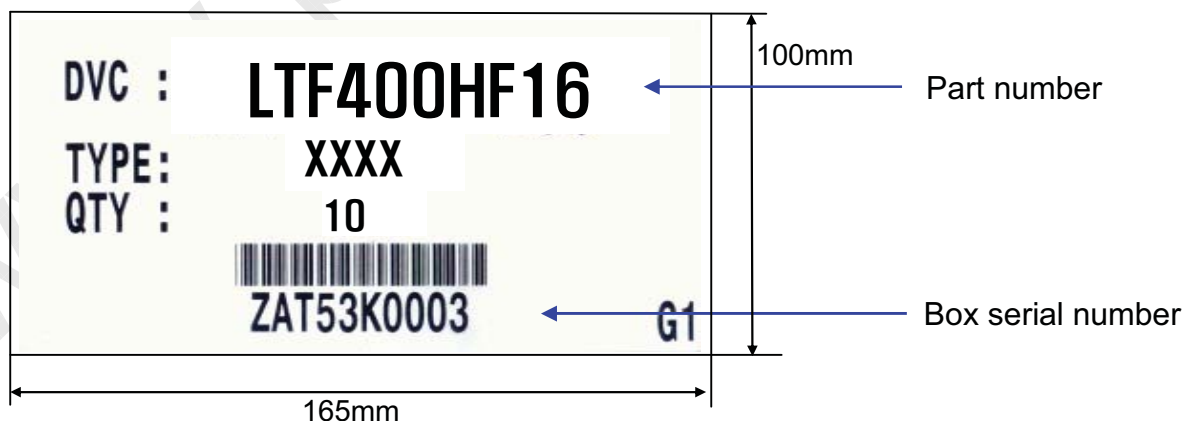
- (1) Part number : LTF400HF16
- (2) Revision: Three letters
- (3) Lot number : X X X X XXX XX X



(4) Nameplate Indication



(5) Packing box attach



(6) Others

- 1. After service part

Lamps cannot be replaced because of the narrow bezel structure.

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11. General Precautions

11.1 Handling

- (a) When the Module is assembled, it should be attached to the system firmly using all mounting holes. Be careful not to twist and bend the Module.
- (b) Because the inverter use high voltage, it should be disconnected from power before it is assembled or disassembled.
- (c) Refrain from strong mechanical shock and / or any force to the Module.
In addition to damage, this may cause improper operation or damage to the Module and CCFL back light.
- (d) Note that polarizers are very fragile and could be damage easily.
Do not press or scratch the surface harder than a HB pencil lead.
- (e) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, staining or discoloration may occur.
- (f) If the surface of the polarizer is dirty, clean it using absorbent cotton or soft cloth.
- (g) Desirable cleaners are water, IPA(Isopropyl Alcohol) or Hexane.
Do not use Ketone type materials(ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.
- (h) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth . In case of contact with hands, legs or clothes, it must be washed away with soap thoroughly.
- (i) Protect the module from Electrostatic discharge. Otherwise the ASIC IC or Semiconductor would be damaged.
- (j) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (k) Do not disassemble the Module.
- (l) Do not disassemble shield case of inverter & LVDS board.
- (m) Do not connect N.C pins. (Samsung internal use only)
- (n) Protection film for polarizer on the Module should be slowly peeled off just before use so that the electrostatic charge can be minimized. Must put on antistatic glove while handle a module
- (o) Pins of I/F connector should not be touched directly with bare hands.

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11.2 Storage

- (a) Do not leave the Module in high temperature, and high humidity for a long time.
It is highly recommended to store the Module with temperature from 0 to 35℃ and relative humidity of less than 70%.
- (b) Do not store the TFT-LCD Module in direct sunlight.
- (c) The Module should be stored in a dark place. It is prohibited to apply sunlight or fluorescent light in storing.

11.3 Operation

- (a) Do not connect or disconnect the Module in the "Power On" condition.
- (b) Power supply should always be turned on/off by the "Power on/off sequence"
- (c) Module has high frequency circuits. Sufficient suppression to the electromagnetic interference should be done by system manufacturers. Grounding and shielding methods may be important to minimize the interference.
- (d) The cable between the back light connector and its inverter power supply should be connected directly with a minimized length. A longer cable between the back light and the inverter may cause lower luminance of lamp(CCFT) and may require higher startup voltage(Vs).

11.4 Operation Condition Guide

- (a) The LCD product should be operated under normal conditions.
Normal condition is defined as below;
 - Temperature : $20 \pm 15^{\circ}\text{C}$
 - Humidity : $55 \pm 20\%$
 - Display pattern : continually changing pattern (Not stationary)
- (b) If the product will be used in extreme conditions such as high temperature, humidity, display patterns or operation time etc., It is strongly recommended to contact SEC for Application engineering advice. Otherwise, its reliability and function may not be guaranteed. Extreme conditions are commonly found at Airports, Transit Stations, Banks, Stock market, and Controlling systems.

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11.5 Others

- (a) Ultra-violet ray filter is necessary for outdoor operation.
- (b) Avoid condensation of water. It may result in improper operation or disconnection of electrode.
- (c) Do not exceed the absolute maximum rating value. (supply voltage variation, input voltage variation, variation in part contents and environmental temperature, and so on)
Otherwise the Module may be damaged.
- (d) If the Module keeps displaying the same pattern for a long period of time, the image may be "sticked" to the screen.
To avoid image sticking, it is recommended to use a screen saver.
- (e) This Module has its circuitry PCB's on the rear side and should be handled carefully in order not to be stressed.
- (f) Please contact SEC in advance when you display the same pattern for a long time.

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